Plasmonic Routes to Nanophotonics

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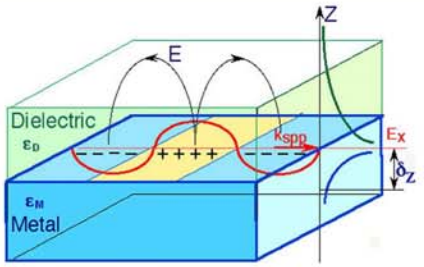
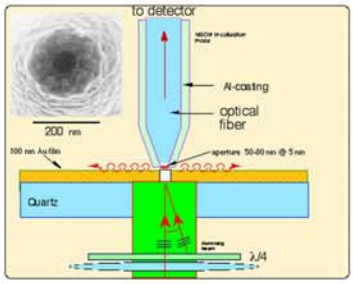
- **Surface Plasmon Polaritons (SPP) in conducting materials:**
  - -confine light energy in a nanoscale layer
  - -strongly enhanced light fields: non-linear effects
- **Combine power of optics and miniaturization of electronics**
- **Photonic microchips for advanced information processing and sensing**
  - -increased speed and sensitivity, reduced power losses
- **Understanding light / plasmon effects in nanostructures**
  - -development of physical background for design and application of SPP nanosources, nanowaveguides, and active elements



δ_z^{Ag}~30 nm

k_x depends on ε_D -> chem/bio sensing

Local generation and manipulation of plasmon beams in nano-structured metal/dielectric films

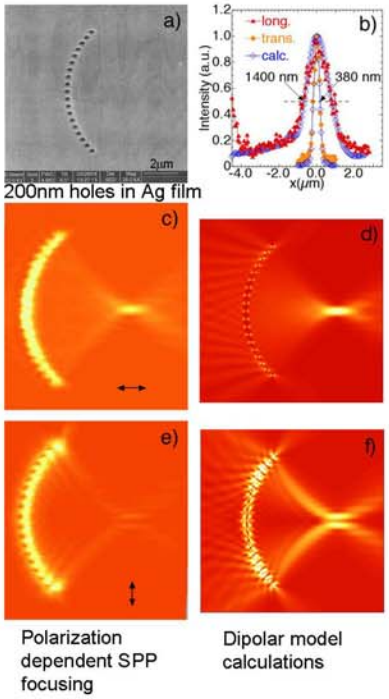


Near-Field Scanning Optical Microscopy

Nanoholes and slits (100-200nm) effective SPP sources

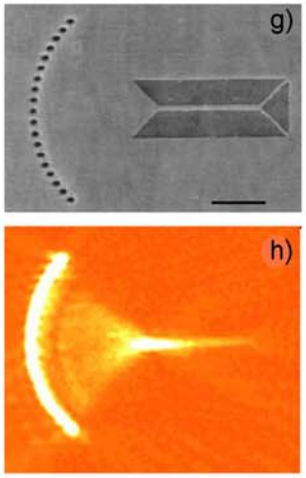
Rational design of coherent SPP sources:

- **sub-wavelength focusing**
- **launching into 250-nm Ag guide**
- **building blocks for nano-photonics**



Polarization dependent SPP focusing

Dipolar model calculations



(g) SEM: focusing array and nanoguide FIB patterned in Ag(50nm) (bright) / Cr(100nm) (dark) bi-layer; 2-μm scale bar.
(h) NSOM image of SPP intensity

Future Directions: Functional materials & optical circuits

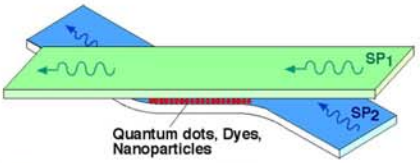
Incorporation of optically active elements

- -quantum dots, resonant cavities, nanoparticles, dyes
- -bio-molecules (sensing),

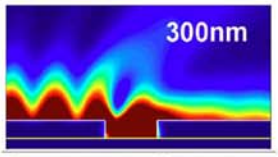
Novel nanocomposites with engineered optical properties

- -plasmon resonances, dispersion relations
- -low-loss metal-dielectric hybrids
- -left-handed meta-materials
- -nanoporous templates for tailoring optical hybrids:

Periodic patterns **p<<λ** -> New optical modes



SPP waveguides coupled through nonlinear optical material: plasmonic switch



FDTD

Resonant tunneling across a 300-nm gap in a 100-nm Ag-film

L.Yin et al., Appl. Phys. Lett. 85, 467 (2004); Nano Lett. 5, 1399 (2005)

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